Chemical Hand Protection Training

Guidance for Shipboard Maintenance Personnel, Work-Center Supervisors, Safety Officers, Hazardous Material Coordinators and Medical Department Personnel

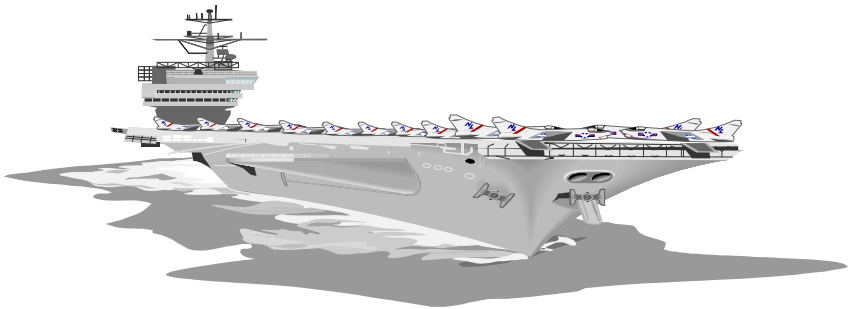
Training Developed by the
Navy PPE Working Group
and
Naval Safety Center
Last Updated: 05 March 2013

NAVY

FIRE EXTINGUISHER

Objectives:

- This presentation is designed to
  - Provide essential information on chemical resistant gloves for:
    - Maintenance personnel
    - Work Center Supervisors
    - Safety Officers
    - Hazardous Materials Coordinators
    - Medical Department Representatives
  - Correct common misunderstandings and ineffective use of chemical resistant gloves



Navy PPE Training Requirements

- *OPNAVINST 5100.23G, paragraph 2013(a)*
  - Activities shall provide training to each employee who is required to use PPE to include at least the following:
    (1) When PPE is necessary
    (2) What PPE is necessary
    (3) How to properly don, doff, adjust and wear PPE
    (4) The limitations of the PPE
    (5) The proper care, maintenance, useful life, storage and disposal of the PPE
    (6) Ability to recognize that defective or damaged PPE shall not be used

- *OPNAVINST 5100.19E, paragraph B1202(c)*
  - Division officers shall ensure that assigned personnel are adequately trained on the type and proper use of PPE required at their work stations…

How to Use This Training

- Be sure to review the instructor notes contained within this training as they provide important additional details

- The most current version of this training can be downloaded from
  - Naval Safety Center's Safety Officer Training Materials web page
    (see Notes)
  - NAVSEA's Maritime DC and PPE Information Center (see Notes)

First Things First

- Before working with chemicals, always check
  - Maintenance Requirement Card (MRC)
  - The product Material Safety Data Sheet (MSDS)/Safety Data Sheets (SDS)
  - The command Industrial Hygiene (IH) survey report
- Receive training on applicable PPE

PPE Should Be the Last Resort!

- Problems with PPE
  - It can fail
  - Sailor can forget to wear it
  - It can be worn improperly

- Can the Sailor be protected by other means (see notes)?
  - Substitution
  - Engineering Controls
  - Administrative Controls

- If the above controls are not feasible or not protective enough, then PPE is appropriate

Hand Protection and Gloves

- Many different types of gloves
  - Chemical resistant
  - Heat resistant
  - Cold resistant
  - Cut resistant (Kevlar)
  - Electrical insulating

- We will concentrate on chemical protective gloves in this training

Hand Protection- Gloves

- Objective is protection from chemical hazards
  - Chemical burns
  - Absorption through skin
    - Local effects
      - Cracking, drying, dermatitis
    - Systemic effects
      - Kidney, liver, central nervous system, cancer

IMPORTANT!!

- No glove is good for <u>all</u> hazards!!!
  - You must know what you're working with and have a glove made from the appropriate protective material
- Some gloves may provide great protection against some chemicals, but provide poor protection from others
- Thickness (mils) plays a part as well
  - A "mil" is a thousandth of an inch

Just How Important Can It Be?

- Dartmouth University Example (link in notes section)
  - PhD Research Chemist
  - Dimethylmercury exposure
  - Just a few drops on surgical latex glove (15 sec exposure)
  - Within 5-6 months symptoms included:
    - Tremors (mouth, tongue, face, head), memory loss, tunnel vision, fatigue, weakness
  - Condition continued to worsen
  - Coma 6 months post-exposure
  - Death 10 months post-exposure

Gloves

- Manufacturers make chemical protective gloves from many different materials
  - Nitrile
  - Neoprene
  - Butyl (synthetic) rubber
  - Polyvinyl Chloride (PVC)
  - Natural latex rubber
  - Multi-layer laminate
  - Polyvinyl alcohol (PVA)
  - Viton® rubber
  - … and several others
- How do we know which to choose?

NSTM 670 Vol. 2

Hazardous Materials User's Guide (HMUG)

- Contains PPE recommendations and information for 20 chemical groups
  - Eye and face protection
  - Gloves
  - Clothing
  - Foot protection
  - Respiratory protection
- Previously was OPNAVINST 5100.28
  - HMUG was incorporated into NSTM 670 in June 2012

Chemical Hand Protection Selection Matrix

- The Navy PPE Working Group developed a Chemical Protective Glove matrix based on the NSTM 670 Hazardous Material User's Guide (HMUG)

- If the Maintenance Requirement Card (MRC) required glove is unavailable, the matrix helps maintenance personnel and their supervisors select a good alternative

Chemical Protective Glove Matrix

- "The Matrix" contains helpful information
  - Instructions on how the matrix should be used
  - Photos of various glove types
  - NAVSEA's Standard PMS Item Name (SPIN)
  - National Stock Number (NSN) information
  - Comparison of protection capabilities of various glove types against many common chemical hazards
- The matrix can be downloaded from
  - Naval Safety Center Personal Protective Equipment webpage (see Notes)
  - NAVSEA's Maritime DC and PPE Information Center (see Notes)

NSTM 670 (Vol. 2) HMUG Chemical Group #	NSTM 670 (Vol. 2) HMUG Chemical Group Name	NSTM 670 (Vol. 2) HMUG Hand Protection (Chemical) Recommendation (See Note 1 below)	Chemical Resistant Glove Type							
			Nitrile (Green "OTTO Fuel") Gauntlet Gloves	Neoprene Gloves	Butyl (Synthetic) Rubber "Toxicological Agents Protective" Gloves	PVC Coated Rubber (Chemical/Oil Protective) Gloves	Black Natural Latex Rubber "Industrial" Gloves	8-mil Disposable Nitrile Gloves	4-mil Disposable Nitrile Gloves	Multi-Layer Laminate Gloves
			SPIN: 02086	SPIN: TBD	SPIN: 02085	SPIN: 00517	SPIN: 00525	SPIN: 02826 (8 mil thick)	SPIN: 17934 (4 mil thick)	SPIN: TBD
Protection offered by each glove type varies depending on the specific chemical used. Click on the "More Info" icons to review the best option for your specific needs.								NOTE: Incidental (Splash) contact only Replace with new glove if contamination occurs		NOTE: Recommend wearing with a disposable nitrile glove over-layer
Group 1	Acids	Acid-Resistant	More Info	More Info	More Info	N	More Info	More Info	More Info	Ok (for all)
Group 2	Alkalies/Bases/Caustics	Rubber	More Info	More Info	Y	Y	Y	More Info	More Info	Ok (for all)
Group 3	Detergents/Soaps	Rubber	Y	Y	Y	Y	Y	Y	Y	Ok (for all)
Group 4	Photographic Chemicals	Rubber	More Info	More Info	Y	Y	Y	More Info	More Info	Ok (for all)
Group 5	Adhesives	Neoprene or Rubber	More Info	Y	More Info	N	More Info	More Info	More Info	Ok (for all)
Group 6	Cleaning Compounds	Rubber	Y	Y	Y	Y	Y	Y	Y	Ok (for all)
Group 7	Aerosols	Neoprene	More Info	Y	More Info	N	More Info	More Info	More Info	Ok (for all)
Group 8	Paint Materials (Oil-Based)	Neoprene for Oil-Based Paints Any Protective Glove for Water-Based	More Info	Y	More Info	N	More Info	More Info	More Info	Ok (for all)
Group 9	Solvents	Solvent-Resistant	More Info	More Info	More Info	N	More Info	More Info	More Info	Ok (for all)
Group 10	Fuels	Neoprene, Nitrile, or Natural Rubber	Y	Y	More Info	Y	More Info	Y	Y	Ok (for all)
Group 11	Lubricants/Oils	Oil-Proof Neoprene or Rubber	More Info	Y	More Info	N	More Info	More Info	More Info	Ok (for all)
Group 12	Hydraulic Fluids	Neoprene for Petroleum-Based Fluids Butyl Rubber for Synthetic, Fire Resistant Fluids	More Info	OK (Petroleum-Based Fluids)	OK (Fire-resistant Fluids)	N	More Info	More Info	More Info	Ok (for all)
Group 13	Greases	Protective Gloves	Y	Y	Y	Y	Y	Y	Y	Ok (for all)
Group 14	Polish/Wax Compounds	Protective Gloves	Y	Y	Y	Y	Y	Y	Y	Ok (for all)
Group 15	Corrosion Preventive Compounds	Rubber	More Info	More Info	More Info	N	More Info	More Info	More Info	Ok (for all)
Group 16	Antifreeze	Chemical Resistant Neoprene, Natural Latex, or Butyl Rubber	More Info	Y	Y	N	Y	More Info	More Info	Ok (for all)
Group 17	Compressed Gases	None	Consult MSDS for proper PPE, if applicable							
Group 18	Oxidizers	Neoprene	More Info	Y	More Info	N	More Info	More Info	More Info	Ok (for all)
Group 19	Fluorescent Lamps	Protective Gloves	Y	Y	Y	Y	Y	Y	Y	Ok (for all)
Group 20	Heavy Metals	Protective Gloves	Y	Y	Y	Y	Y	Y	Y	Ok (for all)

Note 1: In some cases, the HMUG gives only one or two specific glove recommendations. The "More Info" icons in this matrix are designed to allow the user greater flexibility in choosing the appropriate protective gloves. Always review the Material Safety Data Sheet (MSDS) and/or product label to determine which chemical components are in the product.

Glove is recommended by NSTM 670 (Vol. 2) HMUG

Glove is acceptable under certain conditions listed in the block

Glove is not recommended for protection against chemicals in this group

Additional information on proper glove selection is available

Back to the "How to Use This Matrix" Page

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Group 10	Fuels	Neoprene, Nitrile, or Natural Rubber	Y	Y	More Info	Y	More Info	Y	Y	Ok (for all)
Group 11	Lubricants/Oils	Oil-Proof Neoprene or Rubber	More Info	Y	More Info	N	More Info	More Info	More Info	Ok (for all)
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Group 16	Antifreeze	Chemical Resistant Neoprene, Natural Latex, or Butyl Rubber	More Info	Y	Y	N	Y	More Info	More Info	Ok (for all)
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Chemical	Chemical Protection Offered by Various Glove Materials*				
	Neoprene	Natural Latex/Rubber	Butyl	Nitrile	Multi-Layer Laminate
Acetaldehyde	Very Good	Good	Very Good	Good	Excellent
Acetic Acid	Very Good	Good	Very Good	Good	Excellent
Acetone	Good	Very Good	Very Good	Poor	Excellent
Ammonium Hydroxide	Very Good	Very Good	Very Good	Very Good	Excellent
Amyl Acetate	Fair	Poor	Fair	Poor	Not Tested
Aniline	Good	Fair	Fair	Poor	Excellent
Benzaldehyde	Fair	Fair	Good	Good	Insufficient Data
Benzene	Poor	Poor	Poor	Fair	Excellent
Butyl Acetate	Good	Fair	Fair	Poor	Excellent
Butyl Alcohol	Very Good	Very Good	Very Good	Very Good	Excellent
Carbon Disulfide	Fair	Fair	Fair	Fair	Excellent
Carbon Tetrachloride	Fair	Poor	Poor	Good	Excellent
Castor Oil	Fair	Poor	Fair	Very Good	Not Tested
Chlorobenzene	Fair	Poor	Fair	Poor	Excellent
Chloroform	Good	Poor	Poor	Fair	Excellent
Chloronapthalene	Fair	Poor	Fair	Fair	Excellent
Chromic Acid (50% strength)	Fair	Poor	Fair	Fair	Excellent
Citric Acid (10% strength)	Very Good	Very Good	Very Good	Very Good	Not Tested
Cyclohexanol	Good	Fair	Good	Very Good	Excellent
Dibutyle Pthalate	Good	Poor	Good	Good	Excellent
Diesel Fuel	Good	Poor	Poor	Very Good	Not Tested
Diisobutyle Ketone	Poor	Fair	Good	Poor	Excellent
Dimethylformamide	Fair	Fair	Good	Good	Excellent
Dioctyl Pthalate	Good	Poor	Fair	Very Good	Insufficient Data
Dioxane	Very Good	Good	Good	Good	Excellent
Epoxy resins, dry	Very Good	Very Good	Very Good	Very Good	Not Tested
Ethyl acetate	Good	Fair	Good	Fair	Excellent
Ethyl alcohol	Very Good	Very Good	Very Good	Very Good	Excellent
Ethyl ether	Very Good	Good	Very Good	Good	Excellent
Ethylene dichloride	Fair	Poor	Fair	Poor	Excellent
Ethylene glycol	Very Good	Very Good	Very Good	Very Good	Excellent
Formaldehyde	Very Good	Very Good	Very Good	Very Good	Excellent
Formic acid	Very Good	Very Good	Very Good	Very Good	Very Good
Freon 11	Good	Poor	Fair	Good	Not Tested
Freon 12	Good	Poor	Fair	Good	Not Tested

Hand Protection General Selection Procedure

- Identify the hazard(s) of the material you will be working with
  - Review references (MRC, MSDS/SDS, etc.)
- Determine if you will have “incidental” or “extended” contact
  - “Incidental”
    - A few splashes or minimal contact
    - Gloves removed soon after exposure
  - “Extended”
    - Immersion in liquid or many splashes
    - Chemical remains on gloves for a long period of time

Hand Protection General Selection Procedure

- Incidental contact
  - Thin, disposable nitrile gloves provide adequate protection against some chemicals
  - Recommend changing glove if it gets contaminated with chemical
  - Cross-check with the Chemical Protective Glove matrix
- Extended contact
  - Thicker gloves of the appropriate material are generally required
  - Cross-check Chemical Protective Glove matrix

Chemical Protective Gloves

- Manufacturers test gloves to determine which provide best protection against specific chemicals

- Testing includes factors such as:
  - How long chemical takes to “break through” glove
  - Damage to glove material caused by the chemical
  - How quickly the chemical permeates through glove

- When in doubt about which glove to use:
  - Recommend use of a nitrile or neoprene glove
  - Multi-layer gloves also provide excellent protection from most chemicals but can be punctured/torn easily and can feel awkward unless used with a thin, nitrile glove on top

Verify Proper Glove Selection

- Proper chemical protective glove selection should always be verified* by
  - Work Center Supervisors
  - Command Safety Officers and/or the Hazardous Materials Coordinator

*See OPNAVINST 5100.19E, paragraph B1203(c)(3)

Let's Run Through a Few Scenarios

Example #1- Corrosion Prevention

- Suppose a maintenance task requires the use of Corrosion Preventive Compound (SPIN #00322)
- Maintenance task involves brushing corrosion prevention compound on parts
- Suppose the risk of hand exposure is low (incidental splash potential)
- Which glove provides the appropriate protection?

Example #1- Corrosion Prevention

- Step #1: Determine specific composition of the corrosion prevention compound
  - MSDS/SDS indicates aliphatic mineral spirits (petroleum distillates) and several chlorofluorocarbon (CFC) propellants
- Step #2: Assess the potential exposure risk
  - Maintenance task involves no immersion of hands in material, but there is some risk of incidental splashes

Example #1- Corrosion Prevention

- Step #3: Review Pertinent Resources
  - Determine HMUG group and check HMUG recommendation
    - Corrosion Preventive Compounds = HMUG Group #15
    - HMUG Group #15 recommends “Rubber Gloves”
      - This is vague… there are several different types of rubber
  - Cross-check glove recommendation in product MSDS/SDS
    - MSDS/SDS recommends “Oil Impervious” (also vague!) gloves

Example #1- Corrosion Prevention

- Step #3 (cont'd): Cross-check aliphatic mineral spirits (petroleum distillates) against Chemical Protective Glove Matrix
  - Click on "More Info" in Group #15
  - Scroll down to "Petroleum Distillates"
  - Select appropriate glove type
    - Multi-layer laminate- Excellent
    - Nitrile- Very Good
    - Neoprene- Good
    - Natural latex- Not Recommended
    - Butyl Rubber- Not Recommended

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Protection offered by each glove type varies depending on the specific chemical used. Click on the "More Info" icons to review the best option for your specific needs.								NOTE: Incidental (Splash) contact only. Replace with new glove if contamination	
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Group 2	Alkalies/Bases/Caustics	Rubber	More Info	More Info	T	T	T	More Info	More Info
Group 3	Detergents/Soaps	Rubber	T	T	T	T	T	T	T
Group 4	Photographic Chemicals	Rubber	More Info	More Info	T	T	T	More Info	More Info
Group 5	Adhesives	Neoprene or Rubber	More Info	T	More Info	N	More Info	More Info	More Info
Group 6	Cleaning Compounds	Rubber	T	T	T	T	T	T	T
Group 7	Aerosols	Neoprene	More Info	T	More Info	N	More Info	More Info	More Info
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Group 13	Greases	Protective Gloves	T	T	T	T	T	T	T
Group 14	Polish/Wax Compounds	Protective Gloves	T	T	T	T	T	T	T
Group 15	Corrosion Preventive Compounds	Rubber	More Info	More Info	More Info	N	More Info	More Info	More Info
Group 16	Antifreeze	Chemical Resistant Neoprene, Natural Latex, or Butyl	More Info	T	T	N	T	More Info	More Info
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Group 18	Oxidizers	Neoprene	More Info	T	More Info	N	More Info	More Info	More Info
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	Neoprene	Natural Latex/Rubber	Butyl	Nitrile	Multi-Layer Laminate**
Kerosene	Very Good	Fair	Fair	Very Good	Excellent
Ketones	Good	Very Good	Very Good	Poor	Excellent
Lacquer thinners	Good	Fair	Fair	Poor	Excellent
Lactic acid (85%)	Very Good	Very Good	Very Good	Very Good	Not Tested
Lauric acid (36%)	Very Good	Fair	Very Good	Very Good	Not Tested
Lineolic acid	Very Good	Poor	Fair	Good	Not Tested
Linseed oil	Very Good	Poor	Fair	Very Good	Not Tested
Maleic acid	Very Good	Very Good	Very Good	Very Good	Not Tested
Methyl alcohol	Very Good	Very Good	Very Good	Very Good	Excellent
Methylamine	Fair	Fair	Good	Good	Fair
Methyl bromide	Good	Fair	Good	Fair	Not Tested
Methyl chloride	Poor	Poor	Poor	Poor	Excellent
Methyl ethyl ketone	Good	Good	Very Good	Poor	Excellent
Methyl isobutyl ketone	Fair	Fair	Very Good	Poor	Excellent
Methyl methacrylate	Good	Good	Very Good	Fair	Excellent
Monoethanolamine	Very Good	Good	Very Good	Very Good	Not Tested
Morpholine	Very Good	Very Good	Very Good	Good	Excellent
Naphthalene	Good	Fair	Fair	Good	Excellent
Napthas, aliphatic	Very Good	Fair	Fair	Very Good	Excellent
Napthas, aromatic	Good	Poor	Poor	Good	Excellent
Nitric acid	Good	Fair	Fair	Fair	Excellent
Nitric acid, red and white fuming	Poor	Poor	Poor	Poor	Very Good
Nitromethane (95.5%)	Fair	Poor	Fair	Fair	Excellent
Nitropropane (95.5%)	Fair	Poor	Fair	Fair	Excellent
Octyl alcohol	Very Good	Very Good	Very Good	Very Good	Not Tested
Oleic acid	Very Good	Fair	Good	Very Good	Not Tested
Oxalic acid	Very Good	Very Good	Very Good	Very Good	Excellent
Palmitic acid	Very Good	Very Good	Very Good	Very Good	Not Tested
Perchloric acid (60%)	Very Good	Fair	Good	Good	Excellent
Perchloroethylene	Fair	Poor	Poor	Good	Excellent
Petroleum distillates (Napthas/mineral spirits	Good	Poor	Poor	Very Good	Excellent
Phenol	Very Good	Fair	Good	Fair	Excellent
Phosphoric acid	Very Good	Good	Very Good	Very Good	Excellent
Potassium hydroxide	Very Good	Very Good	Very Good	Very Good	Excellent
Propyl acetate	Good	Fair	Good	Fair	Excellent

Page 1

Example #1- Corrosion Prevention

- Step #4: Worker Performance and Comfort
  - Suppose this maintenance involves manipulating small screws and other parts, so a relatively high level of dexterity is needed

- Results
  - At the time of this writing, Multi-Layer Laminate gloves are relatively uncommon though they are very protective
    - However, they would be overkill since the task has a low exposure risk (incidental splash)
  - Nitrile is a good choice
    - Due to low exposure risk, thin (4 mil or 8 mil), disposable nitrile gloves are a good choice

Example #1- Corrosion Prevention

The final Step is for Work Center Supervisor and Safety Officer or Hazardous Materials Coordinator to verify that thin, disposable nitrile gloves are the appropriate alternative to the chemical protective gloves required by the MRC

Example #2- Toluene

- Suppose an MRC requires the use of Toluene, Technical Grade (SPIN #01391)
- Suppose this maintenance task involves high risk of contact with toluene (immersion)
- Which glove provides the appropriate protection?

Example #2- Toluene

- Step #1: Determine specific composition of compound
  - MSDS indicates that toluene (an aromatic hydrocarbon) is the only component of product
- Step #2: Assess the Potential Exposure Risk
  - Suppose maintenance task involves partial immersion of hands in material

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Group 6	Cleaning Compounds	Rubber	Y	Y	Y	Y	Y	Y	Y
Group 7	Aerosols	Neoprene	More Info	Y	More Info	N	More Info	More Info	More Info
Group 8	Paint Materials (Oil-Based)	Neoprene for Oil-Based Paints Any Protective Glove for Water-Based	More Info	Y	More Info	N	More Info	More Info	More Info
Group 9	Solvents	Solvent-Resistant	More Info	More Info	More Info	N	More Info	More Info	More Info
Group 10	Fuels	Neoprene, Nitrile, or Natural Rubber	Y	Y	More Info	Y	More Info	Y	Y
Group 11	Lubricants/Oils	Oil-Proof Neoprene or Rubber	More Info	Y	More Info	N	More Info	More Info	More Info
Group 12	Hydraulic Fluids	Neoprene for Petroleum-Based Fluids Butyl Rubber for Synthetic, Fire Resistant Fluids	More Info	OK (Petroleum-Based Fluids)	OK (Fire-resistant Fluids)	N	More Info	More Info	More Info
Group 13	Greases	Protective Gloves	Y	Y	Y	Y	Y	Y	Y
Group 14	Polish/Wax Compounds	Protective Gloves	Y	Y	Y	Y	Y	Y	Y
Group 15	Corrosion Preventive Compounds	Rubber	More Info	More Info	More Info	N	More Info	More Info	More Info
Group 16	Antifreeze	Chemical Resistant Neoprene, Natural Latex, or Butyl	More Info	Y	Y	N	Y	More Info	More Info
Group 17	Compressed Gases	None	Consult MSDS for proper PPE, if applicable						
Group 18	Oxidizers	Neoprene	More Info	Y	More Info	N	More Info	More Info	More Info
Group 19	Fluorescent Lamps	Protective Gloves	Y	Y	Y	Y	Y	Y	Y
Group 20	Heavy Metals	Protective Gloves	Y	Y	Y	Y	Y	Y	Y

Note 1: In some cases, the HMUG gives only one or two specific glove recommendations. The "More Info" icons in this matrix are designed to allow the user greater flexibility in choosing th

Always review the Material Safety Data Sheet (MSDS) and/or product label to determine which chemical components are in the product.

Glove is recommended by NSTM 670 (Vol. 2) HMUG

Glove is acceptable under certain conditions listed in the block

Glove is not recommended for protection against chemicals in this group

Back to the "How to Use This Matrix" Page

Example #2- Toluene

- Step #3: Review Pertinent Resources
  - Determine HMUG group and check HMUG recommendation
    - Toluene is a Solvent = HMUG Group #9
    - HMUG Group #9 recommends “Solvent-Resistant” Gloves
      - Again, very vague… which glove is best depends on which solvent is used
  - Cross-check glove recommendation in product MSDS
    - MSDS/SDS recommends “Use Gloves” (vague!)
- Neither of these recommendations is very specific… we need to keep investigating

Example #2- Toluene

- Step #3 (cont'd): Cross-check Toluene against Chemical Protective Glove Matrix
  - Click on "More Info" in Group #9
  - Scroll down to "Toluene"
  - Select appropriate glove type
    - Multi-layer laminate- Excellent
    - Nitrile- Fair
    - Neoprene- Fair
    - Natural latex- Not Recommended
    - Butyl Rubber- Not Recommended

Chemical	Chemical Protection Offered by Various Glove Materials*				
	Neoprene	Natural Latex/Rubber	Butyl	Nitrile	Multi-Layer Laminate**
Monoethanolamine	Very Good	Good	Very Good	Very Good	Not Tested
Morpholine	Very Good	Very Good	Very Good	Good	Excellent
Naphthalene	Good	Fair	Fair	Good	Excellent
Napthas, aliphatic	Very Good	Fair	Fair	Very Good	Excellent
Napthas, aromatic	Good	Poor	Poor	Good	Excellent
Nitric acid	Good	Fair	Fair	Fair	Excellent
Nitric acid, red and white fuming	Poor	Poor	Poor	Poor	Very Good
Nitromethane (95.5%)	Fair	Poor	Fair	Fair	Excellent
Nitropropane (95.5%)	Fair	Poor	Fair	Fair	Excellent
Octyl alcohol	Very Good	Very Good	Very Good	Very Good	Not Tested
Oleic acid	Very Good	Fair	Good	Very Good	Not Tested
Oxalic acid	Very Good	Very Good	Very Good	Very Good	Excellent
Palmitic acid	Very Good	Very Good	Very Good	Very Good	Not Tested
Perchloric acid (60%)	Very Good	Fair	Good	Good	Excellent
Perchloroethylene	Fair	Poor	Poor	Good	Excellent
Petroleum distillates (Napthas/mineral spirits	Good	Poor	Poor	Very Good	Excellent
Phenol	Very Good	Fair	Good	Fair	Excellent
Phosphoric acid	Very Good	Good	Very Good	Very Good	Excellent
Potassium hydroxide	Very Good	Very Good	Very Good	Very Good	Excellent
Propyl acetate	Good	Fair	Good	Fair	Excellent
Propyl alcohol	Very Good	Very Good	Very Good	Very Good	Excellent
Propyl alcohol (iso)	Very Good	Very Good	Very Good	Very Good	Excellent
Sodium hydroxide	Very Good	Very Good	Very Good	Very Good	Excellent
Styrene	Poor	Poor	Poor	Fair	Excellent
Styrene (100%)	Poor	Poor	Poor	Fair	Excellent
Sulfuric acid	Good	Good	Good	Good	Excellent
Tannic acid (65%)	Very Good	Very Good	Very Good	Very Good	Not Tested
Tetrahydrofuran	Poor	Fair	Fair	Fair	Excellent
Toluene	Fair	Poor	Poor	Fair	Excellent
Toluene diisocyanate (TDI)	Fair	Good	Good	Fair	Excellent
Trichloroethylene	Fair	Fair	Poor	Good	Excellent
Triethanolamine (85%)	Very Good	Good	Good	Very Good	Excellent
Tung oil	Very Good	Poor	Fair	Very Good	Not Tested
Turpentine	Good	Fair	Fair	Very Good	Not Tested
Xylene	Poor	Poor	Poor	Fair	Excellent

Example #2- Toluene

- Step #4: Worker Performance and Comfort
  - Suppose this maintenance task doesn't involve small screws or other parts so a high degree of dexterity is not required
- Results
  - Multi-layer laminate, nitrile, and neoprene are options in this example
  - Again, at the time of this writing, Multi-Layer Laminate gloves are relatively uncommon though they are very protective in tasks with high risk of chemical contact and so would make a good choice for this task, if available
  - Nitrile and neoprene are also options since they provide fair protection.
    - However, since the task involves a high risk of contact with the chemical, it's best to select a thicker version of the glove (13 mil) rather than a thinner version (such as the thin (4 or 8 mil) disposable nitrile) as in the last example

Example #2- Toluene

The final Step is for Work Center Supervisor and Safety Officer or Hazardous Materials Coordinator to verify that thicker nitrile gloves (13 mil green Otto Fuel gloves, for example) are the appropriate alternative to the chemical protective gloves required by the MRC

Example #3: Multiple Components

- What if we have a chemical product with several different chemical components?

- For example, suppose a paint is comprised of paint solids dissolved in a mixture of solvents?

Example #3- Multiple Components

- Step #1: Determine specific composition of compound
  - MSDS indicates that the paint solids are dissolved in a mixture of n-butyl alcohol, xylene, and toluene solvents
- Step #2: Assess Exposure Risk
  - Maintenance task involves brush/roller application with only an incidental splash exposure hazard

Example #3- Multiple Components

- Step #3: Worker Performance and Comfort
  - Brush and roller painting doesn't require a high degree of dexterity
  - However, the exposure risk is low so there's no need to burden the maintenance person with an overly thick glove

Example #3- Multiple Components

- Step #3: Review Pertinent Resources
  - Determine HMUG group and check HMUG recommendation
    - Haze Gray paint is a “Paint Material”= HMUG Group #8
  - Cross-check glove recommendation in product MSDS
    - Suppose the MSDS recommends use of “Protective Gloves”

Example #3- Multiple Components

- Step #3, cont'd: Cross-check n-butyl alcohol, xylene, and toluene against Chemical Protective Glove Matrix
  - Click on "More Info" in Group #8
  - Scroll down to appropriate rows
    - There is no "n-butyl alcohol" listed!
    - But a Google search indicates that a synonym for n-butyl alcohol is "Butyl alcohol" (which is listed)

NSTM 670 (Vol. 2) HMUG Chemical Group #	NSTM 670 (Vol. 2) HMUG Chemical Group Name	NSTM 670 (Vol. 2) HMUG Hand Protection (Chemical) Recommendation (See Note 1 below)	Chemical Resistant Glove Type						
			Nitrile (Green "OTTO Fuel") Gauntlet Gloves	Neoprene Gloves	Butyl (Synthetic) Rubber "Toxicological Agents Protective" Gloves	PVC Coated Rubber (Chemical/Oil Protective) Gloves	Black Natural Latex Rubber "Industrial" Gloves	8-mil Disposable Nitrile Gloves	4-mil Disposable Nitrile Gloves
			SPIN: 02086	SPIN: TBD	SPIN: 02085	SPIN: 00517	SPIN: 00525	SPIN: 02826 (8 mil thick)	SPIN: 1793 (4 mil thick
Protection offered by each glove type varies depending on the specific chemical used. Click on the "More Info" icons to review the best option for your specific needs.								NOTE: Incidental (Splash) contact only. Replace with new glove if contamination	
Group 1	Acids	Acid-Resistant	More Info	More Info	More Info	N	More Info	More Info	More Info
Group 2	Alkalies/Bases/Caustics	Rubber	More Info	More Info	T	T	T	More Info	More Info
Group 3	Detergents/Soaps	Rubber	T	T	T	T	T	T	T
Group 4	Photographic Chemicals	Rubber	More Info	More Info	T	T	T	More Info	More Info
Group 5	Adhesives	Neoprene or Rubber	More Info	T	More Info	N	More Info	More Info	More Info
Group 6	Cleaning Compounds	Rubber	T	T	T	T	T	T	T
Group 7	Aerosols	Neoprene	More Info	T	More Info	N	More Info	More Info	More Info
Group 8	Paint Materials (Oil-Based)	Neoprene for Oil-Based Paints Any Protective Glove for Water-Based	More Info	T	More Info	N	More Info	More Info	More Info
Group 9	Solvents	Solvent-Resistant	More Info	More Info	More Info	N	More Info	More Info	More Info
Group 10	Fuels	Neoprene, Nitrile, or Natural Rubber	T	T	More Info	T	More Info	T	T
Group 11	Lubricants/Oils	Oil-Proof Neoprene or Rubber	More Info	T	More Info	N	More Info	More Info	More Info
Group 12	Hydraulic Fluids	Neoprene for Petroleum-Based Fluids Butyl Rubber for Synthetic, Fire Resistant Fluids	More Info	OK (Petroleum-Based Fluids)	OK (Fire-resistant Fluids)	N	More Info	More Info	More Info
Group 13	Greases	Protective Gloves	T	T	T	T	T	T	T
Group 14	Polish/Wax Compounds	Protective Gloves	T	T	T	T	T	T	T
Group 15	Corrosion Preventive Compounds	Rubber	More Info	More Info	More Info	N	More Info	More Info	More Info
Group 16	Antifreeze	Chemical Resistant Neoprene, Natural Latex, or Butyl	More Info	T	T	N	T	More Info	More Info
Group 17	Compressed Gases	None	Consult MSDS for proper PPE, if applicable						
Group 18	Oxidizers	Neoprene	More Info	T	More Info	N	More Info	More Info	More Info
Group 19	Fluorescent Lamps	Protective Gloves	T	T	T	T	T	T	T
Group 20	Heavy Metals	Protective Gloves	T	T	T	T	T	T	T

Note 1: In some cases, the HMUG gives only one or two specific glove recommendations. The "More Info" icons in this matrix are designed to allow the user greater flexibility in choosing th

Always review the Material Safety Data Sheet (MSDS) and/or product label to determine which chemical components are in the product.

Glove is recommended by NSTM 670 (Vol. 2) HMUG

Glove is acceptable under certain conditions listed in the block

Glove is not recommended for protection against chemicals in this group

Back to the "How to Use This Matrix" Page

Chemical	Chemical Protection Offered by Various Glove Materials*				
	Neoprene	Natural Latex/Rubber	Butyl	Nitrile	Multi-Layer Laminate**
Nitromethane (95.5%)	Fair	Poor	Fair	Fair	Excellent
Nitropropane (95.5%)	Fair	Poor	Fair	Fair	Excellent
Octyl alcohol	Very Good	Very Good	Very Good	Very Good	Not Tested
Oleic acid	Very Good	Fair	Good	Very Good	Not Tested
Oxalic acid	Very Good	Very Good	Very Good	Very Good	Excellent
Palmitic acid	Very Good	Very Good	Very Good	Very Good	Not Tested
Perchloric acid (60%)	Very Good	Fair	Good	Good	Excellent
Perchloroethylene	Fair	Poor	Poor	Good	Excellent
Petroleum distillates (Napthas/mineral spirits	Good	Poor	Poor	Very Good	Excellent
Phenol	Very Good	Fair	Good	Fair	Excellent
Phosphoric acid	Very Good	Good	Very Good	Very Good	Excellent
Potassium hydroxide	Very Good	Very Good	Very Good	Very Good	Excellent
Propyl acetate	Good	Fair	Good	Fair	Excellent
Propyl alcohol	Very Good	Very Good	Very Good	Very Good	Excellent
Propyl alcohol (iso)	Very Good	Very Good	Very Good	Very Good	Excellent
Sodium hydroxide	Very Good	Very Good	Very Good	Very Good	Excellent
Styrene	Poor	Poor	Poor	Fair	Excellent
Styrene (100%)	Poor	Poor	Poor	Fair	Excellent
Sulfuric acid	Good	Good	Good	Good	Excellent
Tannic acid (65%)	Very Good	Very Good	Very Good	Very Good	Not Tested
Tetrahydrofuran	Poor	Fair	Fair	Fair	Excellent
Toluene	Fair	Poor	Poor	Fair	Excellent
Toluene diisocyanate (TDI)	Fair	Good	Good	Fair	Excellent
Trichloroethylene	Fair	Fair	Poor	Good	Excellent
Triethanolamine (85%)	Very Good	Good	Good	Very Good	Excellent
Tung oil	Very Good	Poor	Fair	Very Good	Not Tested
Turpentine	Good	Fair	Fair	Very Good	Not Tested
Xylene	Poor	Poor	Poor	Fair	Excellent
Butyl Alcohol	Very Good	Very Good	Very Good	Very Good	Excellent

Example #3: Multiple Components

	Chemical Protection by Glove Type				
Solvent Component	**Nitrile**	**Neoprene**	**Natural Latex Rubber**	**Butyl Rubber**	**Multi-layer Laminate**
n-butyl alcohol	Very Good	Very Good	Very Good	Very Good	Excellent
Xylene	Fair	Poor	Poor	Poor	Excellent
Toluene	Fair	Fair	Poor	Poor	Excellent

Example #3- Multiple Components

- Results
  - The table in this example shows:
    - Multi-layer laminate provides the best protection against the three solvents.
    - All gloves provide good protection from n-butyl alcohol
    - Neoprene, butyl rubber, and natural latex rubber provide poor protection from at least one solvent in the mixture
    - Nitrile provides Fair to Very Good protection against all of the solvents
  - Nitrile and the Multi-Layer Laminate provide the best protection
    - The Multi-Layer Laminate is relatively uncomfortable and is overkill for the application since the likely exposure hazard is low
    - Nitrile is probably the best option.
      - For this application (where only minimal contact is likely), a thin (4 or 8 mil) disposable nitrile would be appropriate

Example #3- Multiple Components

The final Step is for Work Center Supervisor and Safety Officer or Hazardous Materials Coordinator to verify that the thin, disposable nitrile gloves are an appropriate alternative to the chemical protective gloves required by the MRC

What if…

- What if neither the HMUG, MSDS, or Chemical Protective Glove matrix gives good guidance on the best glove?

- Support Structure
  - Command Safety Officer
  - Command Hazardous Materials Coordinator
  - Supporting Industrial Hygiene office
  - Chemical protective glove manufacturers

What Else is Important to Know?

- Proper glove maintenance!
  - Gloves don't last forever!
- Damage to gloves can and DOES occur and can affect the
  - Permeation
  - Degradation
- Always "pre-flight" the gloves to check for damage before wearing
- Always wash your hands after glove use

Checking Gloves Before Use

- Check for holes
  - Step 1: Hold the glove by the cuff and “flip” it several times to trap air inside
  - Step 2: Hold the glove near your face while gently squeezing the glove. If you feel air hitting your face the glove may have a hole and could need replacing
  - Step 3: If no air is felt then glove likely does not have a hole. Move to next slide.

Check for Glove Damage

- Dispose of gloves if you see
  - Discolored areas
  - Sticky, gummy areas
  - Fingers sticking together
  - Pinholes, tears, or blisters in the glove material
  - Areas where the glove texture has changed or rubbed off
  - Cracks where glove was folded over itself
  - Areas where chemicals, oils/grease have dried onto the glove

Chemical Protective Glove Types

Nitrile "Otto Fuel" Gloves

- "Nitrile" is a type of synthetic rubber
- Provides good protection against solvents, oils, hydraulic fluids, dilute acids/bases
- Also known as "Gloves, Chemical and Oil Resistant, Disposable"
- A common glove recommended for onboard maintenance
- Gloves should be discarded if exposed to OTTO fuel

Nitrile “OTTO Fuel” Chemical Resistant Gloves

Neoprene

- Neoprene is another type of synthetic rubber
- Provides wide range of protection against chemicals in several groups
  - Organic solvents
  - Oils
  - Peroxides
  - Fuels
  - Hydrocarbons
  - Alcohols
  - Acid/bases

Neoprene Chemical Resistant Gloves

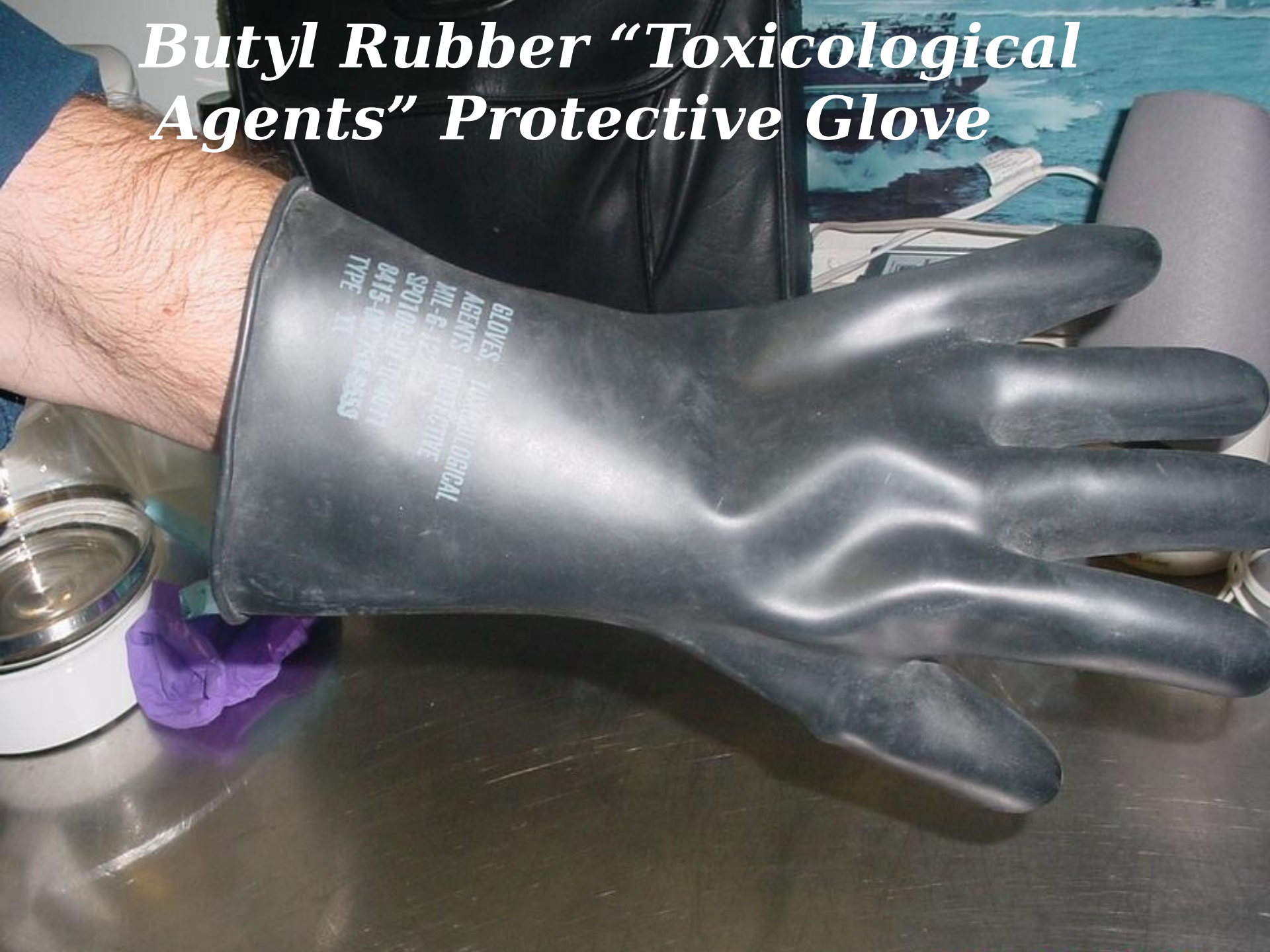
These are stock photos of neoprene gloves from various manufacturers.

Display does not constitute endorsement of a particular product.

Butyl Rubber

- Butyl rubber is another type of synthetic rubber
- Good chemical resistance against many chemicals
  - Very good against acids/bases
  - Good protection against some solvents
- Generally offers relatively poor dexterity

Butyl Rubber "Toxicological Agents" Protective Glove



Polyvinyl Chloride-Coated Natural Latex Rubber

- Natural latex rubber gloves with PVC coating
- Provide resistance against some chemical groups
  - PVC is not generally good against solvents
- Have a cotton inner lining
- Limited dexterity

PVC-Coated Natural Rubber Gloves

Natural Latex Rubber

- Black colored “Industrial” Gloves
  - Gauntlet length (about 14” long)
  - Somewhat similar in appearance to electrical safety gloves
    - ***Don’t get them mixed up!!***
    - ***These are <u>not</u> designed to provide electrical protection!!***

Natural Latex Rubber

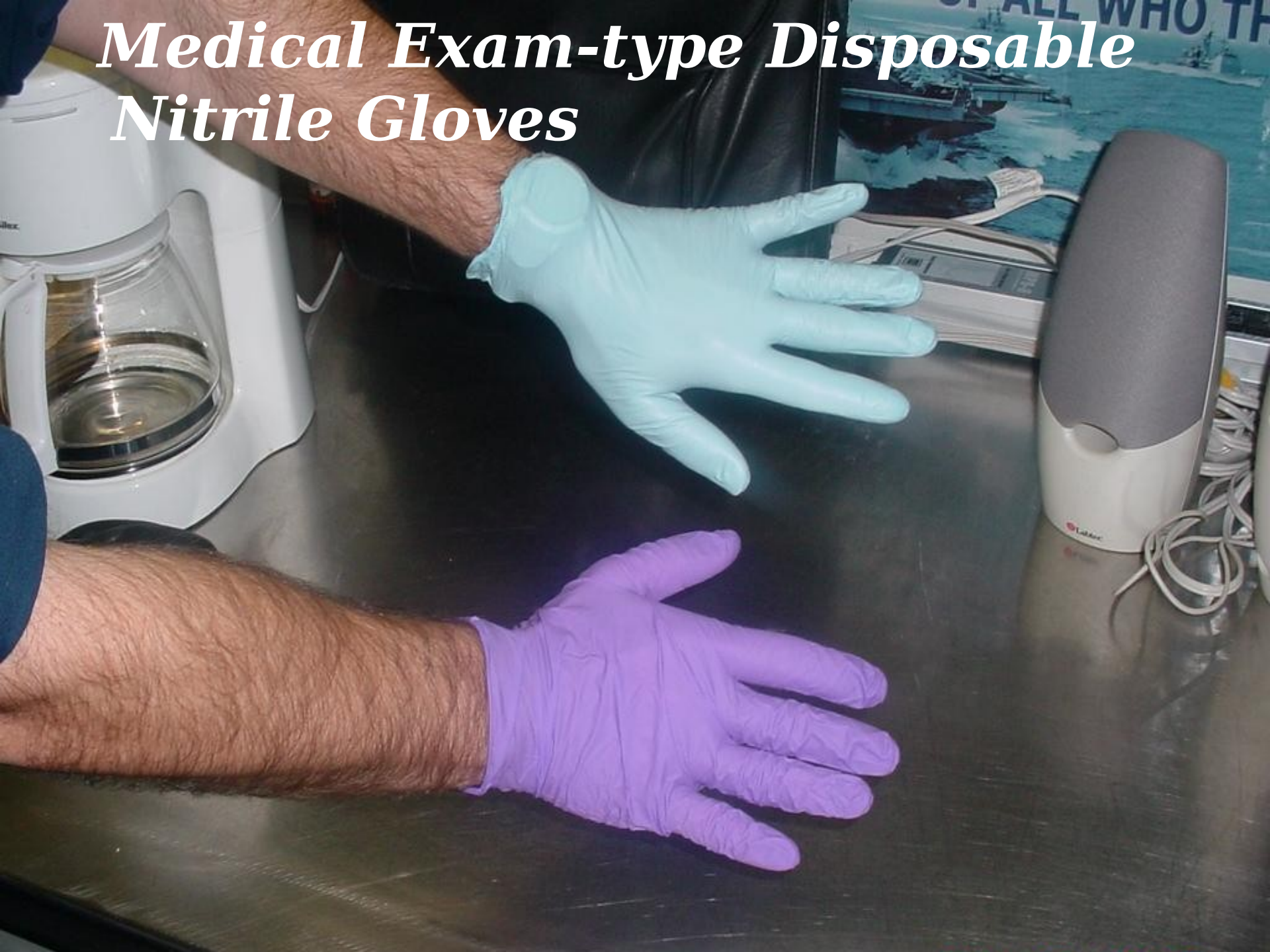
- Provides protection against some acids and bases (acids/bases). For example:
  - Cleaning compounds
- Natural latex rubber does not provide good protection against most solvents or oil-based chemicals
  - Doesn't protection well against hydraulic fluid, paint solvent, gasoline, kerosene, most cleaning solvents (Acetone is an exception)

Natural Latex Rubber “Industrial” Glove

Disposable Nitrile

- Similar to latex medical glove, but made from nitrile
  - Popular because of cost and allows good dexterity
  - Provides chemical resistance for various chemicals
    - Not good for heavy exposure or immersion in chemical
  - Can be used as an under-layer or over-layer for other gloves

Medical Exam-type Disposable Nitrile Gloves



Multi-Layer Laminate Gloves

- Provides highest level of protection to more chemicals than any other glove type
- Very thin (2.7 mil), allows good dexterity
- Feels “strange” at first due to laminate construction, but a thin, nitrile outer glove helps the laminate material better conform to the hand

Multi-Layer Laminate Gloves

Gloves that should NOT be used for protection against industrial chemicals

Non-Nitrile Disposable Gloves

- Surgical Latex (medical exam gloves)
  - Do NOT provide any chemical resistance
  - Will dissolve in oil-based solvents
  - ONLY to be used for medical purposes
- Vinyl (food processor gloves)
  - Also provide little chemical resistance
  - Designed for hygiene during food processing

Surgical Latex and Food Processor Vinyl Gloves
Do not use for chemical protection!!

Chemical, Biological, and Radiological (CBR) Gloves

- Made from thick Butyl Rubber
  - Provides resistance to a wide variety of chemical and biological warfare agents
  - Designed for use with MOPP gear
- Similar to “Toxicological Agents” glove
- CBR Gloves come in a Set
  - Two Butyl rubber overgloves
  - Two cotton undergloves
- Very expensive, don’t use for daily maintenance

CBR Butyl Rubber "Glove Set"

Proper Glove Storage

- Do not store gloves that have chemical residue on them
- Do not store gloves in a folded position
- Do not store PPE in HAZMAT locker due to potential chemical contamination and degradation of protective material
- Ensure all PPE is properly cleaned/sanitized prior to storage

A Key to Success!

- Wearing the proper PPE!
  - Most mishaps occur when either the wrong protective glove is worn or the glove is taken off before the work is complete
  - Work Center Supervisors MUST be the first line of enforcement

Another Key to Success

- Make sure your gloves are in good condition!
  - Make sure you “pre-check” gloves!
    - Check for cracks, pin holes, degradation, etc.
  - If chemical resistant gloves can’t be cleaned, discard them and order a new pair
  - Dispose of “disposable” gloves

General Precautions

- Ensure you have the correct type of chemical protective glove for the task
- Thoroughly inspect gloves prior to use
- Wash hands once gloves have been removed
- Once removed, disposable gloves should be discarded
- Non-disposable/reusable gloves may be washed, as needed, and then inspected for tears, holes, degradation, and other damage
- Remove gloves before touching personal items, such as phones, computers, pens, doorknobs, etc.
- If a glove fails and hazardous chemicals come into contact with skin, seek medical attention as needed and inform your supervisor and the command Safety Manager/Officer

Feedback

- If you identify problems with PPE recommendations in the MRC, NSTM 670 HMUG, or other references:

- Submit a feedback report using the appropriate form (usually in the reference itself) so that the problem can be resolved

Other Chemical Hand Protection Resources

- Federal OSHA PPE Guide (link in notes)
- NIOSH Skin Exposures and Effects webpage (link in notes)
- Chemical resistant glove manufacturer websites

And Now for a Test!

- Did this sailor make a good glove choice?

- Bonus Points: What about his other PPE choice(s)? Why?

If you have questions or comments regarding this presentation please contact the Naval Safety Center feedback line:

safe-oshfdbk@navy.mil

If you don't know,asl